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RECENT USSR DEVELOPMENTS IN PRODUCTION AND APPLICATION OF CHEMICAL INSECTICIDES AND FUNGICIDES

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[Comment: The following report summarizes a part of an article published under the title "The Chemical Industry in the Fight for Increased Yields and for the Preservation of Crops (Concerning the Opening of the All-Union Agricultural Exposition)."]

Fungicides are widely used in combating plant diseases caused by fungi and bacteria. Green plants and fruit are commonly treated with fungicides for purposes of prophylaxis and therapy. As far as insecticides are concerned, DDT is widely used in the USSR. However, DDT does not have any acaricidal activity. For that reason, it must be applied together with acaricides for the protection of some crops (e.g., DDT in combination with sulfur is used in cotton fields.)

The ester of a sulfonic acid (p-chlorophenyl ester of p-chlorobenzenesulfonic acid) shows promise as an acaricide and is being subjected to tests at present. A by-product of DDT production, i.e., p-chlorbenzenesulfonic acid, serves as a starting material for the production of ester.

DDT is used most frequently in agriculture in the form of dusts dispersed from planes. Emulsions and suspensions of DDT are also being applied. Although the application of aerosols of DDT is of interest, DDT in this form is used only on a limited scale at present. The same applies to DDT solutions in organic solvents.

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Another important insecticide is hexachlorane (hexachlorocyclohexane). One of the immediate tasks of the chemical industry will be production of a hexachlorane enriched in gamma-hexachlorocyclohexane, i.e., production of hexachlorocyclohexane containing no less than 60% of the gamma-isomer. The nontoxic isomers will then be used to produce herbicides and agents for the treatment of seeds. Furthermore, the process of enrichment will tend to reduce the disagreeable odor of this chemical, thus contributing to an expansion of its use in agriculture.

An example of a preparation that is used for the treatment of seeds and contains gamma-hexachlorocyclohexane is merkuran, which consists of 12% of gamma-hexachlorocyclohexane, 2% of ethylmercurichloride, and 76% of a filler.

Among chlorine derivates one may note chlortene (khlorten), which is prepared from the pinene fraction of turpentine. This preparation is effective both as an insecticide and an acaricide. It is of particular importance for use in orchards and cotton fields. Of great interest are chlorinated hydrocarbons which are prepared by the diene synthesis. Compounds of this type are useful for the control of pests which infest the soil and pests which damage cotton and other crops. These compounds comprise "khlorindan" [chlordan?] and heptachlor (geptakhlor), which are being subjected to extensive tests under field conditions at present.

Halogenated derivatives of aliphatic hydrocarbons are also used in combating agricultural pests. Among compounds of this type one may not dichloroethane, carbon tetrachloride, and methyl bromide. The last mentioned compound is used for the fumigation of plants. Chloropicrin is used for the extermination of granary pests.

Organophosphorus insecticides are of exceptional interest to agriculture. The development of organophosphorus compounds suitable for application as insecticides became possible as a result of work done by Soviet investigators, primarily A. Ye. Arbuzov, B. A. Arbuzov, and the members of their school. The Arbuzovs are successfully engaged in the development of new and effective organophosphorus insecticides, among which one may mention octamidophos (oktamidofos), dithio (ditio), and others. The organophosphorus insecticide NIUIF-100 is well known. The active principle of this preparation is diethyl-4-nitrophenylthiophosphate.

Organophosphorus insecticides are distinguished by a high insecticidal and acaricidal activity which surpasses that shown by compounds of any other class. One of the drawbacks of compounds of this class is their extremely high toxicity towards warm-blooded animals and humans, so that special precautions must be observed when these compounds are applied. However, since organophosphorus compounds have a low stability under field conditions, their use even on food crops is permitted.

In addition to the insecticides mentioned above, metaphos (dimethyl-4-nitrophenylthiophosphate) and carbophos (dimethyldicarboethoxyethyldithiophosphate) are of interest. Carbophos combines a low toxicity to warm-blooded animals with an adequate insecticidal and acaricidal activity.

Systemic insecticides deserve particular attention. These insecticides are transported throughout the vascular system of plants and lend to the plants insecticidal properties for a certain period of time. Among insecticides of this type octamidophos and vnuran (beta-ethylmercaptotriethylthiophosphate)

have been investigated most thoroughly. Their application will depend on the results of investigations as to whether the fruit of plants treated with them may not acquire harmful properties.

Insecticides containing phosphorus are best applied in the form of emulsions prepared by diluting concentrates consisting of the insecticide and an emulsifier. They can also be applied as dusts or in the form of powders which form suspensions with water.

An idea of the effectiveness of organophosphorus compounds can be obtained by taking into consideration that the application of NIUIF-100 in combating various pests makes possible an increase in the yield of cucumbers by a factor of 8 and of that of tangerines by a factor of 2. The use of this insecticide in cotton fields saves 3-4 centners per hectare of cotton which would have been lost otherwise.

In addition to insecticides, the chemical industry supplies agriculture with very effective agents for the control of plant diseases. The production of NIUIF-2 (granosan "granozan"), which is being used extensively at present, will be doubled within the next 2-3 years. Treatment with NIUIF-2 of the seeds of many different crops serves as protection against a wide variety of fungal and bacterial plant diseases. Only very small quantities of NIUIF-2 are needed to disinfect the seeds. This agent not only disinfects seeds completely, but also stimulates the growth of plants. The work on NIUIF-2 was begun at the initiative of A. N. Nesmeyanov, whose investigations of organic mercury compounds occupy a leading place in chemistry.

Tests on other agents for the treatment of seeds have also bee completed successfully. Some of these agents are tetramethylthiuram disulfide (the most effective chemical for the treatment of carrot seeds), copper 2,4,5,-trichlorophenolate (to be used in the treatment of cotton seeds for the prevention of gummosis), and hexachlorobenzene and pentachloromononitrobenzene (agents for the treatment of wheat seeds against smut). The last three chemicals can be prepared from nontoxic [to insects] isomers of hexachlorocyclohexane over trichlorobenzene.

Although none of the chemicals enumerated in the last paragraph has the universal activity exhibited by NIUIF-2, these chemicals may still replace NIUIF-2 in areas where fusariosis and helminthospirosis are absent.

A number of preparations that are to be used as fungicides on green plants are now being tested. These preparations include 15% dinitrothiocyanobenzene to which copper oxychloride has been added, iron dimethyldithiocarbamate, tetramethylthiuram disulfide, ethylenebisdithiocarbamates of various metals, and other substances. Dinitrothiocyanobenzene with added copper oxychloride has given good results in the control of grape mildew, apple scab, and other plant diseases.

Notwithstanding the forthcoming considerable increases in the volume of production of organic synthetic substances, a number of inorganic chemicals will retain their importance as agents for the chemical protection of plants. Among these chemicals are arsenicals (calcium arsenate, Paris green, calcium arsenite, and sodium arsenite), barium chloride, sodium silicofluoride, copper sulfate, ground sulfur and sulfur in lumps, colloidal sulfur, preparation AB for the treatment of seeds, etc.

The chemical industry also produces the very effective rodenticide zinc phosphide and the insecticide KEAM (concentrated emulsion of anthracene oil), which is used to exterminate wintering pests of fruit trees and fruit-bearing bushes. The importance of zinc phosphide as a chemical for the extermination of animals [rodents] has increased since the methods for its applications have been perfected. The work on the improvement of these methods was carried out at the All-Union Institute of Plant Protection. There can be no doubt that the production of zinc phosphide will be increased considerably during the next few years. During recent years, as a result of the expansion of mechanical cotton picking, an increased demand has developed for chemicals to be used in the defoliation of cotton plants. Calcium cyanamide to which sodium silicofluoride has been added to the ratio of 2:3 is used as a defoliant. Thus, the reduction of the demand for sodium silicofluoride on the part of agriculture, which had begun to develop, did not proceed further. The renewal of the demand for this chemical serves the needs of the chemical industry in view of the forthcoming expansion of superphosphate production.

Although the organomercury agent NIUIF-2 for the treatment of seeds is being applied extensively, the preparation AB (a combination of basic copper sulfate with basic copper carbonates containing 15-16% of active copper) is also being used.

As far as arsenicals are concerned, mixtures of calcium arsenate with synthetic chemicals such as DDT, hexachlorocyclohexane, thiophos, and "khlorindan" may prove to be of advantage. The new arsenical, manganese arsenate, which contains only 25% As_2O_5, does not yield in effectiveness to calcium arsenate, which contains 38-42% As_2O_5.

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